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Table 1.--Magnetic expression of some mineral deposits, prospects, and shows in the Lake Clark quadrangle, Alaska

of alteration

Local alteration

Alteration

Local alteration

Alteration nearby

Local alteration

Major (minor)

Au(Sn,Ag)

Mo(Zn)

Stream-sediment

geochemical anomaly,

hydrothermal?

Contact

metamorphic

disseminated

Contact(?)

metamorphic,

massive, disseminated

Stockwork,

disseminated, vein

Placer

disseminated, veinlet

Contact metamorphic,

Contact metamorphic,

disseminated, massive

disseminated

Breccia pipe,

vein, disseminated

Breccia, porphyry,

Porphyry, hydrothermal (Cu, Ag)

disseminated, veinlet

Volcanogenic(?),

Vein(?),

volcanogenic(?)

disseminated, vein

disseminated

Contact metamorphic,

disseminated

veinlet, disseminated

vein, disseminated

Contact metamorphic,

disseminated

Contact metamorphic,

Placer

Hydrothermal vein Cu, (Ag, Zn)

massive, disseminated

Cu(Au, Zn)

Hydrothermal stock- Cu(Zn, Pb, Local alteration

(Zn, Ag, Mo)

Cu(Pb,Zn)

Table 2.--Occurrence of geochemical anomalies over or near magnetic rock units in the Lake Clark quadrangle, Alaska

Rock units

Ag --- x x --- x x x x x x x x x x

Mo x --- x --- x x --- x x x

W --- X X X --- X --- X X

Pb --- x --- x x --- x x x --- x x

Bi X --- X X --- X X --- X X X --- X

Hg --- X --- X --- X .--- X .--- X ---

Th --- x --- x x x x x --- x x

Zn X --- x X --- x X --- x --- x ---

Cu x x x x --- x x x --- x x ---

Cu(Fe,Zn) Local alteration

Cu(Zn,Pb, Local alteration

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Presence or absence Nature of associated Nearest exposed

magnetic anomaly

Magnetic low; possible

Flank of magnetic high

Flank of magnetic high

Flank of magnetic high

Low-amplitude high or

plateau; local lows

Flank of magnetic low

Flank of magnetic high

Magnetic low

Low-amplitude highs and lows KJs+TKi

Magnetic low, flanks of highs Tv

Magnetic high, possible MzPzm

Low-amplitude magnetic high TKi+KJs

Low-amplitude magnetic high TKi+KJs

Low-amplitude magnetic low Tv

Low-amplitude magnetic low Tv

Flank of magnetic high and low Tv+TKi

Flank of magnetic high

Flank of magnetic high;

Flank of magnetic high;

Flank of magnetic high;

Flank of magnetic high;

magnetic lineament

magnetic lineament

magnetic lineament

magnetic lineament

magnetic lineament

Flank of magnetic high;

Flank of magnetic high;

Aeromagnetic high and low; Ti+Tv

Magnetic high; near magnetic Ti+Ki

Flank of magnetic high; near Ti+Ki

High-amplitude magnetic high; Tv+Ti

Magnetic high and flank of Tv+Ti

magnetic lineament

magnetic lineament

magnetic lineament

magnetic lineament

possible lineament

Magnetic highs and low:

Magnetic low; flank of

magnetic high; possible

Magnetic highs and low;

magnetic highs; possible

Magnetic highs and lows;

magnetic lineament

magnetic lineament

Flank of magnetic high;

Magnetic high; flanks of

Flank of magnetic high

magnetic low

Magnetic high

Magnetic high

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Map MF-870-B, two sheets, scale 1:250,000.

(See sheet 2) Name

3 Telaquana River

4 Telaquana Pass

5 Glacier Fork

6 Neacola River

7 Bonanza Hills

12 Twin Lakes East

15 Pass Lake West

17 Kijik Lake

19 Kijik Mountain

24 Portage Creek

Upper (South)

30 East Takoka Creek

31 Kasna Creek

33 West Gladiator

37 Little Tazimina

Currant Creek

26 North Currant Creek Breccia pipe,

27 South Currant Creek Contact metamorphic,

postulated for anomalies E-H, the geometry of the body producing the positive anomaly may be quite different than that shown on figure 3B. Other positive anomalies in the central magnetic province are produced by Cretaceous or Tertiary plutons, by Tertiary volcanic rocks, or by Paleozoic volcanic rocks, as shown on sheet 2.

terrane of Tertiary volcanic rocks, Cretaceous or Tertiary plutons, and these rocks is not clear, but we postulate that hydrothermal alteration may, in part, have converted original magnetite to pyrite or other weakly magnetic iron oxides. Several mineral deposits or prospects occur in the area, and The eastern part of the map is dominated by ovoid highs and lows of high amplitude and steep gradient. The lows have a strong correlation with low topography as a result of the drape-flying process. In this province the Jurassic, Cretaceous, and Tertiary plutons are nearly all moderately to

plutons in the northeastern part of the map. Some of the negative anomalies correlate with thick glaciers, but a few

(Detterman and Reed, 1980). 1,500 to 2,000 gammas occurs over Iliamna Volcano. Large positive magnetic anomalies are common over other major volcanic edifices, such as Moun Veniaminof, Black Peak, and Aniakchak Crater to the south in the Chignik and

10 km or more. Most of these are thought to represent fault zones. Some of the lineaments coincide closely to mapped fault zones, but others do not. Prominent magnetic lineaments are parallel to the Lake Clark fault zone, although individual mapped strands of the fault zone do not everywhere coincide with the magnetic lineaments. Most of the lineaments are close to topographic lineaments. Not all magnetic lineaments have been plotted on sheet 2. Because some ore deposits appear to be associated with lineaments, as discussed below, additional magnetic lineaments should be identified by those interested in their use as a prospecting guide. A very inconspicuous magnetic lineament trends northeast and corresponds to the inferred Mulchatna fault shown on Beikman's geologic map of Alaska (1980). If the fault actually exists, it does not involve rocks having

Aeromagnetic anomalies in the vicinity of known ore deposits, prospects, nature of any associated magnetic anomaly. The location of the deposits are numbered on sheet 2. Numbers of deposits progress generally from west to east

King and others (1985) and Nelson and others (1985). Sites of geochemical samples are not evenly distributed over the quadrangle, and extensive tracts of glacial deposits complicate the geochemical picture. A few generalized correlations between the occurrence of metallic elements with magnetic provinces and groups of magnetic anomalies can be postulated as shown on table Gold - Geochemical anomalies are rare or absent near magnetic units Ji, Ji+Ki, Tv+MzPzm, Tv+TKi, and Tv+TKi+MzPzm. Gold anomalies are more common in the northwest and central magnetic provinces than in the southeast.

height greater than 300 m; therefore, some apparent anomalies result from the geometry of the actual survey. For example, magnetic lows may appear over valleys if the topography is carved in a magnetic medium even though magnetic abundant in the southeastern province. properties do not vary laterally. On the other hand, if the magnetic basement is buried beneath the topographic relief, magnetic highs may occur over valleys because the aircraft is actually closer to the magnetic basement than over the ridges, even though the distance above the ground surface may be found in the northwestern and central magnetic provinces. greater over the valleys. A possible additional effect is that of the Earth's ain dipole field: an increase in elevation of 1 km above sea level can decrease the main field by about 25 gammas. Griscom (1975) further discussed and they are rare in the central province. A generalized interpretive map (sheet 2) has been prepared from combined analysis of the aeromagnetic map (sheet 1) and the regional geologic map (Nelson and others, 1983). Subjective boundaries have been drawn around most provinces but are rare in the southeastern province. of the major magnetic anomalies or groups of anomalies, commonly zones of

steepened magnetic gradient, and these areas are interpreted in terms of the associated rocks that probably cause the anomalies. Where groups of anomalies have composite or multiple sources, more than one symbol has been used on the three magnetic provinces. interpretation map, and such combined symbols (Tv+TKi, for example) may be regarded as representing a "magnetic rock" unit in subsequent discussion of mineral deposits and geochemical anomalies. The northwestern magnetic province is characterized by gentle magnetic younger units of the southeastern province. gradients and small positive and negative anomalies of low amplitude. Most of the Mesozoic flysch terrane is relatively nonmagnetic. Small positive anomalies in the northwestern province are probably caused by small concealed ntrusive masses or volcanic rocks. As in the Lake Clark quadrangle, the provinces but appear to be more common in younger units. deformed Mesozoic flysch terrane of the Talkeetna quadrangle to the north has

1979). The central magnetic province contains anomalies having gentle gradients and low amplitudes and anomalies of high-amplitude and steep gradients, both over patches of igneous rocks. The southeastern magnetic rovince is characterized by many high-amplitude positive and negative nomalies over the plutonic-volcanic complexes of the southern Alaska Range. a regional low over Jurassic plutons in the southeastern part of the area may be a separate province, but is not labeled separately. Boundaries between these four magnetic provinces are arbitrary and are drawn considering the geology as well as the magnetic field. Many closed magnetic lows are present on the aeromagnetic map. The map has been carefully compared with the topographic and geologic maps in an attempt to determine which lows are produced by the following mechanisms: 1. Topographic lows related to drape-flying (T) 2. Lows produced by reversed remanent magnetization (R)

Lows produced by alteration (A). 1. Lows over thick glaciers (G) 5. Lows due to polarization of magnetic bodies (P) On the interpretation map only the larger negative anomalies (amplitudes greater than 30-50 gammas) are shown.

low and subdued in comparison to the central and eastern parts. Magnetic anomalies are generally of low amplitude, less than 10 gammas, and of gentle gradient, characteristic of flysch terranes. This pattern is consistent with a depth to magnetic basement of 2-5 km or more beneath the flight elevation. A few areas of small positive and negative anomalies, labeled  $\underline{i}$ , probably are caused by small buried(?) plutons, but volcanic intercalations within the Tysch sequence cannot be discounted. The probability of igneous sources for magnetic high areas A and B is reinforced by the presence of geochemical anomalies (from stream-sediment samples) of tungsten, silver, bismuth, tin, gold, and lead from these areas (King and others, 1985). Gradients on the flanks of most of the small anomalies suggest depths of 2 km or more beneath the aircraft, but one prominent positive anomaly (T. 10 N., R. 30 W., area C) of about 200 gammas has steep gradients on its flanks, indicating that the source is buried less than 1 km below the glacial deposits

station Avana in T. 4 N., R. 36 W (area D). Geochemical anomalies of tin The small closed negative anomalies that are common in the northwest magnetic province may be caused by reversed remanent magnetization associated with contact alteration of the flysch around plutons, as discussed more fully in the section on the central magnetic province.

Central magnetic province The central province is a mixed province, geologically and magnetically. The main geologic unit is the Mesozoic flysch, intruded by plutons which have variable degrees of magnetization. Local patches of volcanic rocks and a block of Paleozoic metavolcanic and metasedimentary rock are also present. Most of the anomalies in this province are labelled on sheet 2 as to probable origin and will not be further discussed here. Four groups of anomalies, however, are of special significance because of possible correlations with metallic deposits or because of rather uncommon geophysical expression. Anomaly area E, over the Bonanza Hills in the north-central parof the quadrangle, comprises a magnetic plateau over plutons in its central A pair of anomalies of special interest to students of magnetic potential

One large area of rather gentle magnetic gradients, north of Chulitna Bay, in Tps. 2 and 3 N., Rs. 30 and 31 W., overlies a geologically variable Mesozoic metamorphic rocks. The reason for lack of magnetic expression of geochemical anomalies of bismuth, arsenic, silver, copper, tin, lead, and

strongly magnetic and produce anomalies having amplitudes of several hundred to several thousand gammas. Detailed analysis would probably show that specific plutons have characteristic anomalies: for example, if magnetic terrain corrections were made, it should be possible to detect more distinctive magnetic expression of the individual plutonic bodies. Many of the roof pendants are accompanied by large positive anomalies; whether the anomalies over the pendants are caused by volcanic material in the pendants or by underlying batholithic rocks is unknown. It appears that middle Tertiary plutons extending from the north edge of the map area to near the Tlikakil River are somewhat less magnetic than older plutons, especially Cretaceous

In the extreme southeast corner of the quadrangle, a magnetic high of

Because of unfavorable source and reservoir rocks, the potential for oil, gas, and coal resources appear to be minimal in the Lake Clark quadrangle. However, the terrane may be favorable for radioactive minerals and geothermal resources (Iliamna Volcano). Lode and placer deposits or prospects, some of potential economic interest, include those containing gold, copper, molybdenum, iron, zinc, tin, and lead. Details of the known deposits are contained in the report by Nelson and others (1985) and of geochemical anomalies in a report by King and others (1985). and geochemical anomalies have been examined to determine if correlations occur. For convenience, table 1 lists and describes the deposits and the

Placer deposits and geochemical anomalies from stream-sediment samples (deposits 2, 7, 8, 13, 22, 24, and 39) are not expected to be directly expressed by aeromagnetic anomalies; rather, aeromagnetic anomalies over probable upstream sources are more significant. Probable sources for placer gold deposits 7 and 8 are Cretaceous and (or) Tertiary plutons that intrude the flysch sequence in the Bonanza Hills. Aeromagnetic expression of this area was described in a previous section of the report. Placer gold deposit 2 is near lode gold deposits 21 and 23, which occur on and near major aeromagnetic lineaments. Placer deposit 24 is near lode gold deposit 25, which also is located along a major aeromagnetic lineament. Deposit 39, a

Contact metamorphic and contact hydrothermal deposits of molybdenum, copper, silver, zinc, and iron are associated with magnetic lows (deposits 3 and 31), flanks of magnetic highs (deposits 4, 5, 14, 31, and 38), on magnetic highs (deposits 12, 14, 27, and 38), and associated with magnetic lineaments (deposits 3, 12, 27, and 31). Thus, all types of anomalies are associated with these deposits. Perhaps the most significant correlation is that the largest known copper deposit (Kasna Creek, deposit 31) (see Reed, 1967; Warfield, 1951) is near a zone of inferred northeast-trending lineaments. These relations suggest that lineaments, whether of fault or other origin, have been a partial control for localization of contact-related deposits. Hydrothermal vein deposits that have variable proportions of gold, copper, lead, silver, zinc, and molybdenum occur at sites of magnetic lows (deposits 9, 10, 15, 16, 17, 18, 26, 34, and 37) and magnetic highs or flanks of highs (deposits 15, 18, 20, 21, 23, 26, 28, 29, 32, 33, 34, and 35). Many of these deposits are associated with magnetic lineaments (deposits 20, 21, 23, 26, 28, 29, 32, 33, and 34). Volcanic-related deposits, breccia pipes and veins (deposits 11 and 19) are associated with magnetic lows (deposits 11, 16, and 17), the flanks of highs, or both highs and lows (deposits 26 and 30). A few are also associated with lineaments. Low anomalies over deposits 11, 16, 17, 26, and 30 may be

Silver - Silver anomalies are rare or absent near units Ji, Ji+Ki, Ti, and i+Tv, but have been found from all other magnetic units. Silver anomalies are present in all three magnetic provinces Geochemical anomalies are rare or absent near units Ti, i, i+Tr

Ki+MzPzm, MzPzm, Ti+Tv, and Tv+MzPzm. Tungsten anomalies are found in all Lead - Geochemical anomalies are found near units TKi, Tv, Ti+MzPzm, i, i+Tv, Ti+Tv, Tv+TKi, Tv+TKi+MzPzm. Lead appears to be rare in the northwest province, more common in the central province, and still more common in

> northwest province, more common in the central province, and most common in the southeastern province in the younger rock units. Mercury - Geochemical anomalies occur near units Ji+Ki, Ti, Ki+MzPzm, and Ti+Tv. No special correlations of mercury with magnetic provinces were found. Thorium - Geochemical anomalies occur near units Ti+Ki, Tv, Ti+MzPzm, Ki+MzPzm, Ti+Tv, and Tv+TKi+MzPzm. Thorium anomalies appear to be rare or absent in the northwest and central provinces and are locally abundant over Ti+Ki areas of the southeastern province.

flysch terrane) contain geochemical anomalies of gold, tin, and tungsten. Peninsular terrane and Alaska-Aleutian Range batholitic complex) is

deposits in the Lake Clark quadrangle appear to be magnetic highs near the major magnetic lineaments, especially those that coincide with or are close to major mapped fault zones, and in the vicinity of the plutons that produce reversed anomalies around their peripheries (anomalies in areas E-I) in the central magnetic province. Another area having major geochemical anomalies of many metals is the region of the magnetic low near mineral deposits 15, 16, 17, and 18, which may indicate extensive hydrothermal alteration of original

ACKNOWLEDGMENTS

To summarize, the more favorable sites for exploration for mineral

M. A. Lanphere and B. L. Reed provided samples of granitic rocks for susceptibility measurements. Magnetic susceptibilities were measured by Robert Morin. B. L. Reed, R. J. Jachens, and R. L. Detterman provided helpful review of the manuscript. Christine Carlson colored the aeromagnetic map to assist in the interpretation and provided laboratory and field data pertinent to the background geologic base.

An aeromagnetic survey was flown over the Lake Clark 1:250,000

quadrangle, Alaska, in 1977-1978, as part of the Alaska Mineral Resource

Assessment Program (AMRAP). Lines were flown about 1.6 km apart at a nominal

eight of about 300 m above the ground surface. The total-intensity magnetic

field was measured by a proton-precession magnetometer. The International Geomagnetic Reference Field (IGRF) of 1975, updated to 1978, was removed from

the observed field data, and the resulting map of residual magnetic anomalies,

contoured by computer at an interval of 10 gammas using a grid interval of 400

which has been composited with the topographic base, and sheet 2, an

interpretation map which is superimposed on a simplified geologic base and the

reports by Nelson and others (1983, 1985), Eakins and others (1978), Bundzten

nd Kline (1979), and Reed and Lamphere (1972, 1973, 1974). Results of

geochemical analyses of stream-sediment and rock samples have been prepared by

King and others (1985), and appraisal of the resources of the quadrangle has

been prepared by Nelson and others (1985). A summary of the regional

geologic setting of the Iliamna and Lake Clark areas was given by Detterman

The eastern part of the quadrangle includes the Chigmit Mountains and

other elements of the southern Alaska Range. The western part consists of

owlands with small groups of isolated hills and mountains. Parts of several

eologic terranes of southern Alaska occur in the Lake Clark quadrangle (fig.

that is a continuation of a flysch belt that extends southwest from the

Talkeetna quadrangle (Reed and Nelson, 1977; Jones and others, 1981) into the

western part of the Lake Clark quadrangle, and (2) the Alaska-Aleutian Range

batholith which, in part, was emplaced in the Peninsular terrane of Jones and

aeromagnetic data. Most groups trend approximately northeast across the

Unit KJs - a graywacke, mudstone, and slate terrane in the northwestern half of the quadrangle. These rocks are largely of late Mesozoic age

(Late Jurassic and Cretaceous?) as determined from scant faunal data from

the Lake Clark and Talkeetna quadrangles (Reed and Nelson, 1977). These

strata probably represent deep-water turbidite deposits. They are highly

deformed and locally isoclinally folded, and they are of low regional

metamorphic grade (zeolite facies). In a few places, the strata are

intruded by granitoid plutons and exhibit contact metamorphism. Locally,

they are overlain by younger extrusive volcanic rocks. Most of the flyschoid units trend northeast. Thickness of the sequence is unknown,

of the volcanic sequences are not known but map relations suggest that 2 km or more of layered volcanic rocks are present in the center of the

3. Unit Sc - metamorphosed volcanic and sedimentary rocks of Paleozoic age

which is allochthonous with respect to its neighbors.

occur as roof pendants in the batholithic complex.

occur in a small area in the central part of the quadrangle. This unit

includes metabasalt, metachert, fossiliferous limestone and marble, meta-

andesite, and other volcanogenic rocks. Fossils from the limestones

suggest a Silurian age (Bundtzen and others, 1979), and the metamorphic

grade ranges through the zeolite facies to probable lower greenschist

4. Unit MzPzm - a locally fault-bounded metamorphic-igneous complex of

Paleozoic and Mesozoic age trending northeast from the vicinity of Lake

Clark to the Twin Takes area. This belt includes a wide variety of

calc-silicate rocks, serpentinite, gabbro, and chert. These rocks also

Alaska-Aleutian Range batholith trending approximately northeast in the

eastern part of the quadrangle. The Jurassic and Cretaceous belt trends

silicic types. These rocks range in age from Jurassic to middle

batholith, Jurassic granitoid rocks predominate in the southeast

Tertiary (Reed and Lamphere, 1973). In the Lake Clark segment of the

retaceous rocks in the central part, and Tertiary rocks in the

northwestern part, although much overlap occurs. Numerous roof pendants

include: (1) sedimentary rocks, including limestone, and volcanic rocks,

metamorphosed to medium and high grades, some locally associated with

serpentinite (group 4, above); and (2) pendants of metagraywacke, slate,

and hornfelsed volcanic rocks. Some of the volcanic rocks may represent

the metamorphosed Talkeetna Formation of Jurassic age, which is better exposed to the south in the Iliamna quadrangle (Detterman and Reed,

980). Some volcanic pendants are of Tertiary age. Graywacke,

ithologically similar to the late Mesozoic flysch of the western part of

metagraywacke, and slate in some of the northernmost pendants are

6. Unit Qi - flows and associated tuffs and tuff breccias in the southeast

northern part of the Alaska Peninsula and southern Alaska Range.

corner of the quadrangle; the large Quaternary volcanic center of Iliamna

Volcano has produced this unit, a thick pile of andesite described by

The dominant strikes of faults in the quadrangle are northeast to north,

parallel to trends of major rock and geomorphic units. A few northwest-

is part of a system of major regional extent, and it may represent a

southwesterly continuation of the Castle Mountain fault zone (Detterman and

others, 1976). If the Lake Clark fault zone is a continuation of the Castle

Mountain fault system, it may have right-lateral displacement of up to 5 km

(north of Lake Clark, Plafker and others, 1975). The sense of displacement on

Mulchatna River (Beikman, 1980), but flyschoid rocks occur on both sides of the lineament, and the sense and amount of displacement are unknown. Major

northeast-trending fault zones are present in the central part of the

quadrangle (Eakins and others, 1978), in places bounding Paleozoic rocks

(unit Sc). The Bruin Bay fault system (southeast of the quadrangle), a major

ectonic boundary of the Alaska Peninsula (Burk, 1965; Detterman and Reed,

1980), is locally overlain by volcanic flows of the Iliamna Volcano in the

Virtually all of the igneous rocks in the Lake Clark quadrangle are

moderately to strongly magnetic, as observed from inspection of the

aeromagnetic and geologic maps, but some Jurassic rocks are only weakly

magnetic. Measurements of magnetic susceptibility have been made for a

because of logistical constraints. Susceptibilities greater than 0.001 cgs

(centimeter-gram-second) unit are sufficient to produce most of the observed

Only nine samples of metasedimentary and metavolcanic rocks were measured

A sample of Mesozoic graywacke is nonmagnetic. Most other flysch

for magnetic susceptibility, and, of these, only one sample, a meta-andesite,

terranes of southern Alaska are generally normagnetic: for example, the

Waldez and Orca Groups (Late Cretaceous and early Tertiary) of the Prince

William Sound region (Case and others, 1979), and the Jurassic and Cretaceous

graywacke of the Talkeetna quadrangle (Griscom, 1979). It should be pointed

relatively magnetic where they have undergone contact metamorphism adjacent to

granitoid plutons. There, pyrrhotite has been formed (probably from pyrite)

and produces negative anomalies indicative of reversed remanent magnetization

similar contact phenomena in this area are suspected, and some examples will

Two samples of Jurassic plutons, from the Kenai quadrangle to the east,

were measured for susceptibility. These samples, which have a very weak

magnetization (fig. 2), are not considered completely representative of the

Jurassic plutons in the Lake Clark quadrangle because some of these plutons clearly have moderate to strong magnetization as indicated by their expression

on the aeromagnetic map. Trondhjemite plutons, however, are probably weakly

0.0039 cgs units, again indicating moderate to strong magnetization.

production of magnetite associated with contact metamorphism.

problems inherent in drape-flying.

magnetic. Regionally, Jurassic plutons are characterized by locally large

Susceptibilities of 13 samples of Cretaceous plutons range from 0.0008 to

Twenty samples of Tertiary granitoid plutons have susceptibilities that

Susceptibilities of 21 samples of intermediate to silicic Tertiary

range from 0.00006 to 0.0049 cgs units. Many measured values are in the range

volcanic rocks range from essentially nonmagnetic to moderately magnetic

(0.0021 cgs units), whereas 29 samples of mafic to intermediate Tertiary

volcanic rocks have susceptibilities that are as much as 0.0078 cgs units.

Many susceptibilities of these andesites and basaltic andesites are in the

INTERPRETATION OF THE AEROMAGNETIC MAP

area, drape-flying at a constant elevation of 300 m above the surface was

impossible to achieve. Flight elevations were approximately 300 m over ridge

crests and lakes, but over the narrow deep glacial valleys the aircraft could

not safely maintain a constant height above the surface and normally flew at a

Because of the rugged steep terrain in most of the eastern part of the

range of 0.001 to 0.004 cgs units. The abnormally high values of

susceptibilities (>0.005 cgs units) for a few samples probably are related to

0.001 to 0.0025 cgs units, which indicate moderate to strong magnetization.

out, however, that some sandstone units from the Talkeetna quadrangle are

(Griscom, 1979). Because this belt of Mesozoic flyschoid rocks, intruded by

plutons, extends from the Talkeetna quadrangle into the Lake Clark quadrangle

limited number of samples from some of the rock units of the area (fig. 2) but remanent magnetizations were not measured by the Geological Survey group

Topographic lineaments suggest a large fault zone parallel to the

most of the mapped faults is unknown, but many faults are high angle.

extreme southeast corner of the quadrangle.

has a susceptibility greater than 0.001 cgs unit.

magnetic anomalies (Reed and Lanphere, 1973, p. 2606).

striking faults have been mapped, however. The Lake Clark fault zone probably

Juhle (1955). Iliamna Volcano is one of several active volcanoes in the

metamorphosed mafic volcanic rocks, phyllite, schist, quartzite, marble,

5. Units Ji, Ki, TKi, Ti, Tv - a major plutonic-volcanic complex of the

cies. This unit probably is a distinct tectonostratigraphic terrane

Six main groups of rocks are pertinent to this interpretation of the

others (1981) and Coney and others (1980)

quadrangle near Twin Lakes.

area. From northwest to southeast they include:

. The two major terranes are: (1) a belt of deformed upper Mesozoic flysch

This report includes two sheets: sheet 1, the residual aeromagnetic map

Geologic background for this interpretation is provided in a series of

by 200 m, was released by the U.S. Geological Survey (1978).

part, a conspicuous oval negative anomaly of up to 400 gammas around the periphyry, and a series of highs and lows east of the main oval anomaly. We propose that the positive anomalies and the central plateau anomalies are caused by a pluton, and that the plateau anomaly may reflect hydrothermal alteration of the core of the main body. The oval negative anomaly is an expression of reversed remanent magnetization of the flysch related to contact metamorphism, and possible production of pyrrhotite around the main plutons. The Bonanza Hills are the site of the major placer gold deposits in the quadrangle (Eakins, 1980; Eakins and others, 1978). These peculiar anomaly patterns may constitute regional prospecting guides, as has been proposed to the north for the Talkeetna quadrangle by Griscom (1979) and Reed and others (1978). Geochemical anomalies of tungsten, arsenic, gold, tin, silver, lead, and bismuth occur in the area. A second area where similar relations occur between magnetic anomalies and rock distribution is identified between the Chilikadrotna River and The Chilchitna River, near the headwaters of Dummy Creek (anomaly F). Positive anomalies in area F, near triangulation stations Dummy, Ledge, and Pit, occur over plutonic rocks and small patches of volcanic rocks. Geochemical anomalies of tungsten, tin, and gold occur in the area. Negative anomalies occur over the flysch terrane. Similar relations occur in anomaly area G. T. 5 N., R. 32 W., and geochemical anomalies of tin, silver and copper may be associated. Although outcrops are scant, similar relations are interpreted for anomaly area H, north of Tutna Lake. fields occurs in anomaly area I (Tps. 1 and 2 N., R. 35 W.), over a region

covered by glacial deposits (fig. 3A). The relative amplitude of the high is almost 2,400 gammas, and the low has an amplitude of almost 500 gammas. I the low is a normal polarization low, the body causing the anomaly has a thickness that is small compared to its lateral dimensions. To set limits on the dimensions and probable orientation of the magnetization of the body, the magnetic effects of a simple rectangular parallelepiped were computed using a program developed by R. J. Blakely (written commun., 1982). From the steepness of the gradients, it is evident that the top of the body, though covered by glacial material, is nearly at the ground surface. For a simple test model, the following assumptions were made: a planar flight elevation 0.5 km above the top of the body, magnetization azimuth 04°, inclination 72° and apparent magnetization 0.0055 emu/cc. The maximum map dimensions of the body are 3.5 x 4.5 km. The assumed magnetization and thickness of the body were varied until a field map was generated that approximated the observed field. A body 2.5 km thick produces the anomaly shown on figure 3B. Discrepancies between observed and computed anomalies probably result from variation in magnetite content of the body. If the negative anomalies are primarily due to reversed remanent magnetization, however, like those

but probably is several kilometers, or more. These rocks are part of the deformed upper Mesozoic flysch terrane of Jones and others (1981). 2. Units Tv and TKi - a plutonic-volcanic terrane trending northeast across the central part of the quadrangle. Volcanic rocks, which are probably more abundant, include mafic, intermediate, and silicic components. Plutonic rocks are mainly intermediate to silicic. Although isotopic ages are sparse, the data available indicate the rocks are of Late Cretaceous and (or) Tertiary age (Reed and Lamphere, 1972). Thicknesses Southeastern magnetic province

lows probably are associated with areas of hydrothermal alteration, particularly in the southern part of the area near Upper Tazimina an Kontrashibuna Lakes. The large low over Jurassic rocks in the vicinity of Tuxedni River is in part a topographic effect, but in part may be caused by weakly magnetic trondhjemite that extends north from the Iliamna quadrangle

Sutwik Island quadrangles (Case and others, 1981). Magnetic lineaments Numerous zones of steepened magnetic gradient extend along strike for

appreciable contrasts in magnetization in the Lake Clark quadrangle. Aeromagnetic anomalies and resources

possible gold placer, occurs along a poorly-defined magnetic lineament and the flank of a magnetic high.

Details of results of geochemical analyses are provided in the reports by

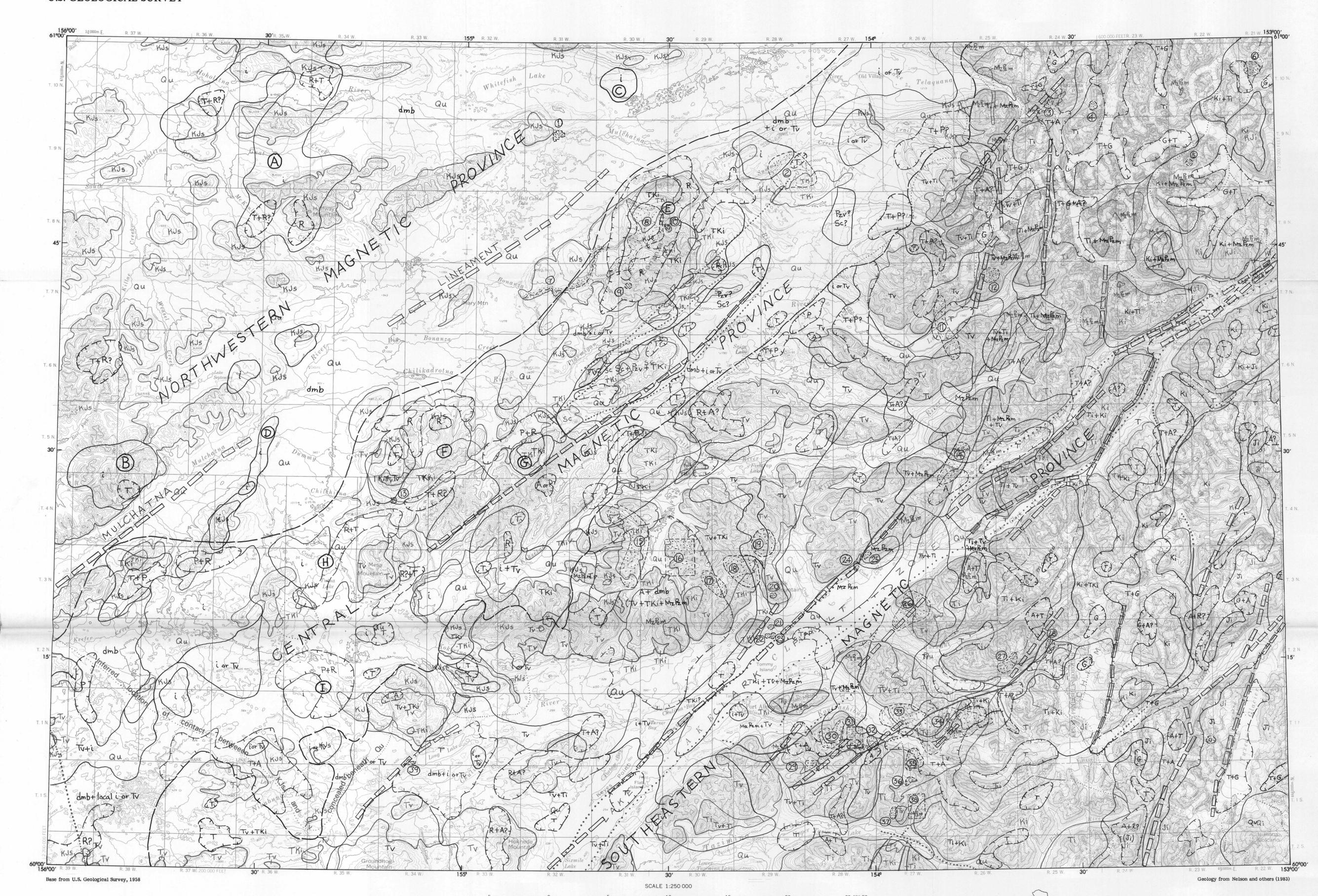
related to hydrothermal alteration of original magnetite to nonmagnetic iron

Tv+TKi, and Tv+TKi+MzPzm. Anomalies of copper appear to be nearly absent from the northwestern and central magnetic provinces, but they are relatively Molybdenum - Geochemical anomalies are reported over magnetic units Ji, Ti+Ki, v, Ti+MzPzm, Ti+Tv, Tv+TKi, and Tv+TKi+MzPzm. No molybdenum anomalies are Zinc - Geochemical anomalies occur near units Ji, Tv, Ti+MzPzm, i+Tv, Ti+Tv, and Tv+TKi. No zinc anomalies are found in the northwestern magnetic province Tin - Geochemical anomalies are found near units TKi, i, i+Tv, Tv+TKi, and Tv+TKi+MzPzm. Tin anomalies are common in the northwest and central magnetic ungsten - Anomalies of tungsten are rare or absent near units Ji, Ti, Tv,

Bismuth - Geochemical anomalies are rare or absent in units Ji+Ki, Ti, Ki+MzPzm, and Tv+MzPzm. Bismuth anomalies are present in all three magnetic little magnetic expression except where intruded by younger plutons (Griscom, Arsenic - Arsenic anomalies are found near units TKi, Tv, Ti+MzPzm, Ti+Tv, Tv+TKi, and Tv+TKi+MzPzm. Arsenic anomalies are rare or absent in the

The northwest and central magnetic provinces (deformed upper Mesozoic

Zinc, molybdenum, copper, and thorium anomalies are rare in both of these provinces, and, additionally, lead and arsenic are rare in the northwest province (fig. 1). In contrast, the southeastern magnetic province characterized by scarcity or absence of gold and tin (tungsten is not very common, either) and by relative abundance of copper, molybdenum, zinc arsenic, and thorium. Whether these general relations persist beyond the borders of the Lake Clark quadrangle remains to be determined. To the northeast, in the Talkeetna quadrangle, the deformed Mesozoic flysch terrane is characterized by geochemical anomalies of tin, tungsten, and gold (Reed and others, 1978), but copper anomalies also occur. As in the Lake Clark quadrangle, the deformed Mesozoic flysch terrane of the Talkeetna quadrangle has little magnetic expression except where intruded by younger plutons (Griscom, 1979).



CONTOUR INTERVAL 200 FEET

aeromagnetic anomalies)

and lows probably caused by

small plutons.

Common: Au, Sn, W

Rare: Zn, Mo, Cu, Th, Pb,

Magnetic field nearly featureless

except for small isolated highs

NORTHWEST MAGNETIC PROVINCE

(Mainly Jurassic and (or) Cretaceous flysch

DEFORMED UPPER MESOZOIC FLYSCH

intruded(?) by plutons interpreted from

NATIONAL GEODETIC VERTICAL DATUM OF 1929 GEOLOGIC INTERPRETATION CORRELATION OF MAP UNITS

> CENOZOIC AND (OR) Ki | CRETACEOUS AND JURASSIC CRETACEOUS (? Sc | SILURIAN > PALEOZOIC

DESCRIPTION OF MAP UNITS SEDIMENTARY DEPOSITS QU UNCONSOLIDATED GLACIAL, GLACIAL FLUVIATILE, ALLUVIAL, AND COLLUVIAL KJs SEDIMENTARY ROCKS (CRETACEOUS? AND JURASSIC)--Graywacke (feldspatholithic sandstone), silty sandstone, and black shale VOLCANIC ROCKS

INFERRED ROCK TYPE CAUSING MAGNETIC ANOMALY--ANDESITIC LAVA AND TUFF OF ILIAMNA VOLCANO (QUATERNARY) Buried in areas covered by glacial deposits, glaciers, water, and alluvium VOLCANIC ROCKS, UNDIVIDED (TERTIARY) -- Rhyolite breccia, ash-flow tuff, flows, and shallow intrusive rocks, and subordinate mafic to Pluton of unknown age Tertiary pluton INTRUSIVE ROCKS Tertiary and (or) Cretaceous pluton Ti MOSTLY GRANITE AND GRANODIORITE, BUT RANGES FROM PERALKALINE GRANITE TO

BOUNDARY OF POSITIVE ANOMALY AREA--Dashed where approximately

than 30-50 gammas. Dashed where approximately located

BOUNDARY OF NEGATIVE ANOMALY AREA--Amplitudes greater

MAGNETIC LINEAMENT--Or zone of steepened magnetic

table 1 and discussion in text

MAGNETIC ANOMALY--Discussed in text

PROBABLE SOURCE OF MAGNETIC LOWS

Polarization

Remanent magnetization

gradient. Approximately located

BOUNDARY OF MAJOR MAGNETIC PROVINCE--Approximately located

MINERAL PROSPECT OR DEPOSIT -- Approximately located.

TKi MOSTLY GRANODIORITE, BUT RANGES FROM GRANITE TO DIORITE (TERTIARY AND Jurassic pluton (OR) CRETACEOUS) Quaternary volcanic rocks Ki GRANITE TO QUARTZ DIORITE (CRETACEOUS) Tertiary volcanic rocks KJi QUARTZ MONZODIORITE (CRETACEOUS? AND JURASSIC?) Paleozoic(?) volcanic rocks Ji TONALITE, TRONDHJEMITE, AND GRANODIORITE (JURASSIC) Silurian metasedimentary and metavolcanic rocks METAMORPHIC ROCKS

Mesozoic and Paleozoic metamorphic rocks MzPzm METAMORPHOSED MAFIC VOLCANIC ROCKS, PHYLLITE, SCHIST, QUARTZITE, ARBLE, CALC-SILICATE ROCKS, SERPENTINITE, GABBRO, AND CHERT Deep magnetic basement (MESOZOIC AND PALEOZOIC) Composite source for anomaly Sc CHILIKADROTNA GREENSTONE (SILURIAN) -- Weakly metamorphosed basalt, andesite, limestone, and tuffaceous sedimentary rocks

> --- ... CONTACT -- Dotted where concealed mostly high angle, many probably

Figure 2.--Magnetic susceptibilities of rock samples. Susceptibility in centimeter-gram-second units.

Figure 1.--Sketch map showing magnetic provinces and principal geochemical anomalies of the Lake Clark quadrangle, Alaska;

SOUTHEAST MAGNETIC PROVINCE

PENINSULAR TERRANE

Tertiary volcanic rocks)

(Mainly Jurassic, Cretaceous, and middle Tertiary

plutons, Paleozoic and Mesozoic pendants, and

Many high-amplitude positive magnetic

related to topographic effects.

Common: Cu, Mo, Zn, As, Th

anomalies. Many negative anomalies, mostly

flight lines. Zero contour is 54,500-gamma contour on sheet 1

1 2 3 4 KILOMETERS

Contour interval 100 and 500 gammas; hachures indicate relative

negative anomalies. Dashed lines are approximate location of

surface dimensions of 3.5 by 4.5 km, thickness of 2.5 km, and

above the top of the body. Contour interval 100 and 500 gammas Hachures indicate relative negative anomaly. Model computed by

magnetization of 0.0055 emu/cc as observed at a level of 0.5 km

Figure 3A.--Simplified residual anomaly map in the vicinity of anomaly I.

Northwestern magnetic province In the northwestern part of the quadrangle the topography is relatively at the surface. Another small shallow pluton is inferred near triangulation occur in the vicinity. Figure 3B.--Magnetic anomaly produced by a rectangular parallelepiped having

MAPS SHOWING AEROMAGNETIC SURVEY AND GEOLOGIC INTERPRETATION OF THE LAKE CLARK QUADRANGLE, ALASKA